MASTER OF SCIENCE
IN
MODELING, VIRTUAL ENVIRONMENTS, AND SIMULATION

AUTONOMOUS-AGENT BASED SIMULATION OF ANTI-SUBMARINE WARFARE OPERATIONS WITH THE GOAL OF PROTECTING A HIGH VALUE UNIT

Fahrettin Akbori-Lieutenant Junior Grade, Turkish Navy
B.S., Turkish Naval Academy, 1998
Master of Science in Modeling, Virtual Environments, and Simulation-March 2004
Advisor: Chris Darken, Department of Computer Science
Second Reader: Curtis L. Blais, Modeling, Virtual Environments, and Simulation Institute

The Anti-Submarine Warfare (ASW) screen design simulation is a program that provides a model for operations in anti-submarine warfare. The purpose of the program is to aid ASW commanders, allowing them to configure an ASW screen, including the sonar policy, convoy speed, and the number of ships, to gain insight into how these and other factors beyond their control, such as water conditions, impact ASW effectiveness. It is also designed to be used as a training tool for ASW officers. The program is implemented in Java programming language, using the Multi Agent System (MAS) technique. The simulation interface is a Horizontal Display Center (HDC) which is very similar to a MEKO200 class Frigate Combat Information Center's (CIC) HDC. The program uses Extensible Markup Language (XML) files for reading data for program scenarios. The simulation also provides all the output data at the end of run time for analysis purposes. The program user's goal, and the purpose of the program, is to decrease the number of successful attacks against surface vessels by changing the configuration parameters of the ASW screen to reflect sonar policy, convoy speed, or number of ships in the simulation. Ongoing use of the program can provide data needed to anticipate required operational needs in future ASW situations.

KEYWORDS: Anti-Submarine Warfare, ASW, Anti-Submarine Warfare, ASW, Screen, Multi Agent Systems, Artificial Intelligence, Protection of High Value Unit, HVU, Combat Information Center, CIC, Naval Simulations, Combat Information Center, CIC, Watch Officer, Sonar Detection, Submarine Torpedo Attack, Decision Making, Cognitive Factors

DEVELOPING AN AFTER ACTION REVIEW SYSTEM FOR A 3D INTERACTIVE TRAINING SIMULATION USING XML

Dimitrios E. Filiagos-Lieutenant, Hellenic Navy
B.S., Hellenic Naval Academy, 1995
Master of Science in Computer Science-March 2004
Master of Science in Modeling, Virtual Environments, and Simulation-March 2004
Advisors: Rudolph P. Darken, Department of Computer Science
CDR Joseph A. Sullivan, USN, Department of Computer Science

An important capability that many modern 3D interactive training simulations lack is an After Action Review System (AARS) that helps both the trainer and the trainee conduct an After Action Review (AAR). Although AAR is not a new idea in the 3D simulation field, it is not widely used in training simulations. In real life training, AAR has proven to be one of the most important phases of the training procedure, sometimes taking the form of debriefing, or in other cases, by conducting a deeper analysis and discussion of the facts. In order to conduct an AAR, a well-designed system must exist to keep track of the conditions and the actions during an exercise, so they can be available for review later. This thesis translates the idea of AAR for real training situations to the 3D interactive simulation domain and also develops an After Action Review System (AARS) using XML technology for capture, analysis, and

interactive playback of an entire simulation training session. Users can change the point of view to any desired position and direction, something that is impossible in video streaming playbacks.

KEYWORDS: After Action Review, After Action Discussion, Capture, Playback, Platform, Platform Path, HLA, Federation

ADAPTIVE MANAGEMENT OF EMERGING BATTLEFIELD NETWORK

Dimitrios P. Fountoukidis-Lieutenant Commander, Hellenic Navy
B.S., Hellenic Naval Academy, 1989
Master of Science in Information Technology Management-March 2004
Master of Science in Modeling, Virtual Environments, and Simulation-March 2004
Advisors: Alex Bordetsky, Department of Information Sciences
John Hiles, Department of Computer Science

The management of the battlefield network takes place in a Network Operations Center (NOC). The manager, based on the importance of the managed network, is sometimes required to be present all the time within the physical installations of the NOC. The decisions regard a wide spectrum of network configurations, fault detection and repair, and network performance improvement. Especially in the case of the battlefield network operations, these decisions are sometimes so important that they can be characterized as critical to the success of the whole military operation. Most of the time, the response time is so restricted that it exceeds the mean physical human response limits. An automated response that also carries the characteristics of human intelligence is needed to overcome the restrictions the human nature of an administrator imposes.

The research will establish the proper computer network management architecture for an adaptive network. This architecture will enhance the capabilities of network management in terms of cost and efficiency.

KEYWORDS: Adaptive Network, SNMP, Mobile Agents, Artificial Intelligence, Collaborative Agents, MANTRIP Project

DISTRIBUTED TEAM COLLABORATION IN A COMPUTER MEDIATED TASK

Amy L. Halin-Lieutenant Commander, United States Navy
B.A., University of Pennsylvania, 1993
Master of Science in Modeling, Virtual Environments, and Simulation-March 2004
Advisors: Rudolph P. Darken, Department of Computer Science
Susan G. Hutchins, Department of Information Sciences

Due to the rapid development of technology, many simple tasks can now be automated, leaving more difficult and cognitive tasks such as planning, decision making and design, to teams. Technology also allows these teams to be distributed through time and space. While this is becoming more and more prevalent in the business world, distributed teams also exist in the military where the stresses are much different.

One of the key factors associated with collaboration in military teams is situational awareness. This research used a commercial command and control type video game to investigate the issues of collaboration and situational awareness. The amount of information available to subjects was varied to determine if there was a significant impact upon their level of situational awareness. Situational awareness was measured by the accuracy of maps that the subjects drew.

Results from this research may provide insight into how much information is needed by distributed teams and when they need it. Ideas for future research in this area have also been proposed.

KEYWORDS: Teams, Situational Awareness, Computer Based Environment

IMPLEMENTATION OF A HUMAN AVATAR FOR THE MARG PROJECT IN NETWORKED VIRTUAL ENVIRONMENTS

Faruk Yildiz-Lieutenant Junior Grade, Turkish Navy
B.S.C.E., Turkish Naval Academy, 1998
Master of Science in Modeling, Virtual Environments, and Simulation-March 2004
Advisor: Xiaoping Yun, Department of Electrical and Computer Engineering
Second Reader: Don McGregor, Modeling, Virtual Environments, and Simulation Institute

The objective of the ongoing MARG project is to animate human motions captured by 15 MARG sensors in a wireless networked virtual environments (NVES). Three avatars were developed previously, but none of them met all the desired requirements. The first one was overly simplistic and did not implement H-Anim standards. The other two were created using laser-scanned data and followed the H-Anim standards, but one had its adjacent joints broken and the other was capable of rotating only one joint. Therefore, we developed the cartoon-type humanoid Andy to meet the needs of the MARG project. The humanoid Andy implements H-Anim standards using built-in X3D humanoid nodes and is capable of controlling all of its 15 joints in NVES.

Another need of the MARG project was a wireless network interface for real-time data streaming. For this purpose, a concurrent client-server program implementing multicasting using Transmission Control Protocol (TCP) and User Datagram Protocol (UDP) was developed. Using WiSER2400.IP serial adapters between the MARG sensors and the server program adds a wireless capability to the project. The server program converts the raw MARG sensor data to quaternions using the Quest algorithm. Multiple clients are supported by the system. Each client program receives the motion data and updates the humanoid Andy.

KEYWORDS: VRML, X3D, Java Network, Java, MARG Sensor, Networked Virtual Environments, Virtual Environments, Humanoid, Avatar, Human Animation, Body Tracking, H-Anim, Control Interface Unit, WiSER2400.IP